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**UNITED STATES ARMY
ENVIRONMENTAL HYGIENE
AGENCY**

ABERDEEN PROVING GROUND, MD 21010

PRINCIPLES AND PRACTICES FOR
MAINTAINING RADIATION EXPOSURE
AS LOW AS IS REASONABLY ACHIEVABLE
AT US ARMY MEDICAL FACILITIES

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Approved for public release; distribution unlimited.

Chapters 2, 3, 4, 5 and the Appendix will be incorporated into the revision of AR 40-37. Chapter 6 has been incorporated into the draft of TB MED 521 (formerly TB MED 62) but not as a single entity.

Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications) to Commander, US Army Environmental Hygiene Agency, ATTN: HSE-RH, Aberdeen Proving Ground, MD 21010.

This technical guide was prepared by:

Mr. Gordon M. Lodde
Health Physicist
Health Physics Division



DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

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PRINCIPLES AND PRACTICES FOR
MAINTAINING RADIATION EXPOSURE
AS LOW AS IS REASONABLY ACHIEVABLE
AT US ARMY MEDICAL FACILITIES

This technical guide has been prepared to assist the commander of a MEDCEN/MEDDAC/DENTAC using radioactive materials and other sources of ionizing radiation for medical purposes develop a radiation protection program. This program shall be in keeping with the philosophy of maintaining radiation exposures (individual and collective) as low as is reasonably achievable (ALARA) for patients, employees, students, and visitors. An Appendix has been developed to assist the radiation protection officer (RPO) in conducting an annual audit of the local radiation protection program.

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CHAPTER 1

INTRODUCTION

1-1. Ionizing radiation is among the most versatile and useful tools of modern medicine and biomedical research. Like many other instrumentalities of medicine, ionizing radiation is potentially hazardous unless used with strict adherence to safety rules and procedures. Thus, the safety rules that govern the uses of radiation sources are concerned with preventing genetic damage as well as with protecting the health of the exposed individual.

1-2. The rules and procedures described herein have one single, straightforward purpose: to protect the patients, employees, students, and visitors from unnecessary and potentially harmful exposure to ionizing radiation.

1-3. A radiation protection program (RPP) has many facets designed to keep the personnel exposure levels as far below the limits as is practicable. The ALARA program has three main phases:

a. To achieve the objective of maintaining radiation exposures (individual and collective) ALARA for patients, employees, students, and visitors.

b. To control operational procedures by the user of radiation sources.

c. To evaluate the RPP performed by the RPO and the Radiation Control Committee (RCC).

1-4. The management of a MEDCEN/MEDDAC/DENTAC shall be committed to a program for keeping radiation exposures (individual and collective) ALARA.

1-5. All primary users of radiation sources shall review current procedures and develop new procedures, as appropriate, for ways to implement the ALARA concept.

NOTE: The words "he," "his," and "him" as used in this bulletin are intended to include both the masculine and feminine genders and any exception to this will be so noted.

CHAPTER 2

RADIATION PROTECTION PROGRAM

2-1. General.

a. The RPP sets forth the philosophy and general management policies established by a MEDCEN/MEDDAC/DENTAC to achieve the objective of maintaining radiation exposures (individual and collective) ALARA for patients, employees, students, and visitors. (See AR 40-5, AR 40-14, and AR 40-37.)

b. In addition to complying with the limits set forth in pertinent Federal and Army regulations, guides, and standards, users and supervisors of radiation sources shall make every reasonable effort to maintain radiation exposures (individual and collective) and releases of radioactive materials in effluents to uncontrolled (unrestricted) areas ALARA. (See AR 40-14, AR 755-15, and AR 200-1.)

2-2. Management Commitment.

a. The MEDCEN/MEDDAC/DENTAC commander and the entire staff shall be committed to developing a program, as described herein, for keeping radiation exposures (individual and collective) ALARA. (See AR 40-14.)

b. The MEDCEN/MEDDAC/DENTAC commander shall provide adequate resources to insure that the RPP is in accordance with current Federal and Army directives for radiation protection. (See AR 40-5, AR 40-14, and AR 40-37.)

c. The RCC, in coordination with the RPO, shall perform a formal review of the RPP annual audit to determine the effectiveness of the ALARA concept (see Appendix).

d. Based on the recommendations of the RPO, and with the concurrence of the RCC and the approval of the MEDCEN/MEDDAC/DENTAC commander, modification to operating procedures, equipment, and facilities shall be made where they will significantly reduce radiation exposures at reasonable costs.

2-3. RCC. In addition to other responsibilities delineated in AR 40-37, the RCC shall:

a. Determine whether current procedures are, in fact, maintaining radiation exposures ALARA. The efforts of the RPO, users, and supervisors of radiation sources, as well as those of management, shall be reviewed during the committee meetings.

b. Review the qualifications of each potential user of radiation sources to assure that the applicant will be able to take appropriate measures to maintain exposures ALARA. (See AR 40-37.)

c. Insure that each user of radiation sources justifies his procedures and use of radiation sources, and that the resulting individual and collective exposures will be kept ALARA.

d. Review the annual audit of the RPP to insure that the overall philosophy and policies of the ALARA concept are being accomplished.

2-4. RPO. In addition to the responsibilities set forth in AR 40-37, the RPO shall:

a. Conduct periodic surveillance programs and investigations to insure that occupational radiation exposures are maintained ALARA. (See AR 40-14.)

b. Communicate directly with the appropriate staff personnel and take necessary corrective action to enforce rules and procedures pertaining to the RPP. (See AR 40-37.)

c. Schedule periodic briefings and educational programs to insure that users and supervisors of radiation sources understand the ALARA philosophy; and, also, that the managers of the RPP are committed to the ALARA concept. (See AR 40-14 and AR 40-37.)

d. Investigate and report all significant instances of deviation from the ALARA concept to the RCC for review.

2-5. Supervisors of Radiation Sources. The supervisor of radiation sources shall:

a. Insure that all radiation sources under his jurisdiction are used by competent personnel.

b. Insure that all personnel assigned to work with radiation sources are trained in good health physics practices and in maintaining their radiation exposures ALARA.

c. Maintain coordination with the RPO to insure that procedures are in accordance with the ALARA concept.

d. Be familiar with all appropriate Federal and Army directives to include local directives concerning radiation protection.

2-6. Radiation Workers. Each radiation worker shall:

a. Take the necessary precautionary measures to protect all personnel from unwarranted radiation exposure.

b. Report any radiation accident or unusual incident to his supervisor and the RPO (NOTE: Instructions on how to contact the RPO should be inserted here.) as soon as possible after the occurrence.

c. Understand and implement the appropriate ALARA procedures developed by the RPO.

d. Be familiar with all appropriate Federal and Army directives to include local directives concerning radiation protection.

2-7. Radiation Exposure Action Levels.

a. These action levels are established based upon a percent of the radiation exposure standards in AR 40-14 and Title 10, Code of Federal Regulations, Section 20.201, and a review of previous radiation exposure histories for the class of operation. The action levels below shall be reviewed and adjusted appropriately upon completion of each quarterly audit of dosimetry records. (See AR 40-14.)

<u>Class of Operation</u>	<u>Action Level (mrem/Quarter)</u>	
	Whole Body	Extremity
(1) Diagnostic Nuclear Medicine	125	1800
(2) Radiopharmaceutical Therapy	125	1800
(3) Teletherapy	125	1800
(4) Brachytherapy	125	1800
(5) Special Diagnostic X-Ray	125	1800
(6) Miscellaneous (Nursing, ICU, Operating Room, etc.)	125	500
(7) Clinical Laboratory	25	200
(8) Routine Diagnostic X-Ray	25	200

b. The action levels stated above are not to be considered as new radiation exposure standards, but as action levels. Any personnel exposure that exceeds the above established action level shall be investigated and appropriate records maintained. As a minimum, the investigation shall include the cause of the exposure, the action taken to correct the situation, and the followup action taken. AR 40-14 establishes the criteria for the investigation of overexposure to ionizing radiation and radioactive material.

2-8. Standards for Radiation Protection. The US Army Environmental Hygiene Agency reviews the overall RPP periodically IAW AR 40-5 and AR 40-37 to determine conformance with current directives. The following services are included:

a. Periodic radiation protection surveys, consultations, and special studies where radioactive materials are used, stored, and disposed of to assure compliance with pertinent Federal and Army regulations, guides, and standards. All MEDCEN/MEDDAC with a nuclear medicine service are inspected annually in accordance with AR 40-37.

b. Periodic radiation protection surveys of diagnostic x-ray facilities to determine conformance with TB MED 62.

2-9. References.

a. AR 40-5, Health and Environment.

- b. AR 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation.
- c. AR 40-37, Licensing and Control of Radioactive Material for Medical Purposes.
- d. AR 200-1, Environmental Protection and Enhancement.
- e. AR 340-18-6, Maintenance and Disposition of General Personnel Management and Safety Functional Files.
- f. AR 755-15, Disposal of Unwanted Radioactive Material.
- g. TB MED 62, Management and Control of Diagnostic X-Ray, Therapeutic X-Ray and Gamma-Beam Equipment Having Energies Up to 10 Million Electron Volts (being revised and renumbered as TB MED 521).
- h. Title 10, Code of Federal Regulations (CFR), Part 19, Notices, Instructions, and Reports to Workers; Inspections.
- i. Title 10, CFR, Part 20, Standards for Protection Against Radiation.
- j. Title 10, CFR, Part 35, Human Uses of Byproduct Material.
- k. Nuclear Regulatory Commission (NRC) Regulatory Guide 8.10, Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable.
- l. NRC Regulatory Guide 8.13, Instructions Concerning Prenatal Radiation Exposure.
- m. NRC Regulatory Guide 8.15, Acceptable Programs for Respiratory Protection.
- n. NRC Regulatory Guide 8.18, Information Relevant to Ensuring That Occupational Radiation Exposures at Medical Institutions Will Be As Low As Reasonably Achievable.
- o. NRC Regulatory Guide 8.20, Applications of Bioassay for I-125 and I-131.
- p. NRC Regulatory Guide 8.23, Radiation Safety Surveys at Medical Institutions.
- q. NRC NUREG-0041, Manual of Respiratory Protection Against Airborne Radioactive Materials.
- r. NRC NUREG-0267, Principles and Practices for Keeping Occupational Radiation Exposures at Medical Institutions as Low as Reasonably Achievable.
- s. International Commission on Radiological Protection, Publication No. 25, The Handling, Storage, Use and Disposal of Unsealed Radionuclides in Hospitals and Medical Research Establishments.

CHAPTER 3

DIAGNOSTIC NUCLEAR MEDICINE, CLINICAL LABORATORY, AND RESEARCH DEPARTMENTS

3-1. General. All radioactive material shall be obtained, used, and disposed of IAW the conditions of the NRC license(s) or DA radioactive material authorization and supporting documents. (See AR 40-37.)

3-2. Radioisotope Laboratory Routine Safety Procedures.

a. Eating, storing, or preparing food; smoking; or applying cosmetics shall be strictly prohibited in areas where unsealed radioactive materials are used or stored. Food and drink shall not be stored in the same place (e.g., refrigerators) with radioactive materials.

b. Direct contact with radioactive materials shall be avoided by using protective laboratory clothing and handling tools. Special precautions shall be taken to avoid the possibility of small amounts of radioactive materials entering into cuts.

c. There shall be NO pipetting of radioactive materials by mouth.

d. Before placing radioactive materials in any container, the container shall be clearly labeled with radiation caution signs or tape, to indicate the particular radionuclide, activity, and date. (See 10 CFR 20.203 and AR 385-30.)

e. All protective clothing, instruments, handling tools, and glassware shall be checked for radioactive contamination with a suitable radiation-survey instrument after use; and, if contaminated, shall be placed in the appropriate receptacle to await decontamination before returning to general use.

f. All radioactive waste shall be deposited in a properly designated and marked radioactive waste container.

g. All spills of radioactive materials shall be reported to the supervisor and the RPO prior to decontamination efforts.

h. At the close of each work period, the laboratory work surfaces shall be carefully monitored for radioactive contamination.

i. Work surfaces shall be covered with absorbent paper where radioactive materials are being used.

j. Each person shall wash his hands thoroughly and check them with a laboratory monitor for radioactive contamination prior to handling telephones or anything that is normally not required during the procedure to avoid needless contamination of objects and before leaving the laboratory after working with radioactive materials.

k. All work with radioactive materials shall be performed utilizing protective laboratory clothing, protective gloves, syringe shields, and remote handling tools as applicable to the procedure being performed.

l. Place radionuclide generators in an area that is separate from other nuclear medicine operations, with appropriate ventilation and shielding to reduce the external as well as internal exposure to personnel during elution.

m. Fume hoods and good radioactive contamination control principles shall be employed when preparing dosages of radiopharmaceuticals that have potential volatility or are radioactive gases or aerosols.

n. Unshielded and open vials containing radioactive material shall not be stored behind bench or fume hood shields that are routinely used for manipulating radiopharmaceuticals.

o. Personnel dosimeters (film badges) shall be worn at all times during work hours, except for medical and dental x-ray appointments. Clearance shall be obtained from the RPO before wearing the film badge after completion of radioisotope treatment. Personnel dosimeters shall not be tampered with and shall be protected from damage. (See AR 40-14.)

p. Any injury or unusual incident shall be reported to the supervisor and the RPO (NOTE: Instructions on how to contact the RPO should be included here.) immediately so the possibility of an overexposure or internal deposition of radioactive material can be investigated.

3-3. References.

a. AR 40-5, Health and Environment.

b. AR 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation.

c. AR 40-37, Licensing and Control of Radioactive Material for Medical Purposes.

d. AR 385-30, Safety Color Code Markings and Signs.

e. Title 10, Code of Federal Regulations (CFR), Section 20.203, Caution Signs, Labels, Signals and Controls.

f. National Council on Radiation Protection and Measurements (NCRP) Report No. 8, Control and Removal of Radioactive Contamination in Laboratories.

g. NCRP Report No. 30, Safe Handling of Radioactive Materials.

h. NCRP Report No. 37, Precautions in the Management of Patients Who Have Received Therapeutic Amounts of Radionuclides.

i. NCRP Report No. 48, Radiation Protection for Medical and Allied Health Personnel.

j. NCRP Report No. 54, Medical Radiation Exposure of Pregnant and Potentially Pregnant Women.

CHAPTER 4

RADIOPHARMACEUTICAL THERAPY

4-1. General.

a. Therapeutic quantities of radioactive materials shall be administered by a physician specifically trained in nuclear medicine to perform such procedures. (See AR 40-37.)

b. A private room with bathroom shall be selected for the radiation therapy patient.

c. The RPO shall monitor the patient area, provide decontamination material, and provide radiation protection special instructions and materials to the patient and nursing personnel. The RPO and the attending physician shall notify nursing personnel when the residual radioactive material in the patient's body is sufficiently low enough to permit the patient to be discharged.

d. The RPO shall monitor the patient area and shall indicate a "safe distance" line for visitors.

4-2. Specific Guidelines for Nursing Personnel.

a. Pregnant nursing personnel should not be assigned the duties of caring for radiation therapy patients. (See AR 40-14.)

b. Consistent with adequate patient care, only minimal nursing procedures should be carried out close to the patient. If the patient's clinical status requires constant observation, personnel required to perform adequate nursing care should be beyond the reproductive age. The patient's bed shall be approached only when required by nursing duties.

c. Nursing personnel shall wear a film badge and a self-reading pocket dosimeter while in the patient area. The film badge of another employee shall NOT be used.

d. A television set, telephone, books, etc., may be provided the patient.

e. The food tray should be prepared entirely with disposable components. The tray should be disposed of as waste within the patient's room. Uneaten food WILL NOT be given to other patients or staff members.

f. The RPO (NOTE: Instructions on how to contact the RPO should be inserted here.) shall be notified AS WELL AS the physician who administered the radioactive material, if any of the following occur:

- (1) Major surgery.
- (2) Transfer of the patient.
- (3) Death of the patient.

g. The patient may have visitors. Visitors should stay on the "safe" side of the line indicated on the floor.

h. Necessary contamination control measures are very similar to isolation techniques:

(1) Cover the mattress and pillow on the bed with plastic or rubber material.

(2) Wear surgeon's gloves when changing bed linen, dressings, etc.

(3) The patient shall wear hospital pajamas.

(4) Place a plastic-lined wastebasket and linen hamper in the patient's room.

(5) Place waste, soiled linen, etc., in the designated containers for monitoring and proper disposition by the RPO.

(6) Personal items for patient care (thermometer, bedpan, etc.) shall be kept in the patient's room. Bath water may be disposed of in the commode.

i. The ambulatory patient should use the commode in HIS room only. The commode should be flushed at least three times after the administration of radioactive material.

j. Diagnostic samples of blood, urine, and feces should only be obtained when authorized by the attending physician.

k. The urine excreted by the patient is radioactive. Spills, bedwetting, or any accident with urine are radiation hazards. Surgeon's gloves are to be worn. In the event of an accidental spill of urine, cover it with absorbent material, then place the material in the designated radioactive waste container. Notify the RPO (NOTE: Instruction on how to contact the RPO should be inserted here).

l. Call the Chief of Medical Supply or hospital engineer and the RPO for correction of plumbing problems. Blocked drains may be a radiation hazard.

m. The room shall NOT be returned to general use (i.e., another patient) until a radiation survey has been performed by the RPO.

4-3. Safety Procedures for the Technicians.

a. While manipulating therapeutic quantities of radioactive material, personnel shall be provided with appropriate handling tools to maximize the distance from the body and the fingers.

b. Therapeutic quantities of radioactive material shall be placed in adequately shielded carts for transport to the patient's room.

c. Finger dosimeters as well as whole-body dosimeters (film badges) and a self-reading pocket dosimeter shall be worn when occupationally exposed to ionizing radiation. The whole-body film badge shall be worn between the shoulders and the hips. (See AR 40-14.)

4-4. References.

a. AR 40-5, Health and Environment.

b. AR 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation.

c. AR 40-37, Licensing and Control of Radioactive Material for Medical Purposes.

d. National Council on Radiation Protection and Measurements (NCRP) Report No. 8, Control and Removal of Radioactive Contamination in Laboratories.

e. NCRP Report No. 30, Safe Handling of Radioactive Materials.

f. NCRP Report No. 37, Precautions in the Management of Patients Who Have Received Therapeutic Amounts of Radionuclides.

g. NCRP Report No. 48, Radiation Protection for Medical and Allied Health Personnel.

h. NCRP Report No. 54, Medical Radiation Exposure of Pregnant and Potentially Pregnant Women.

CHAPTER 5
BRACHYTHERAPY

5-1. General.

a. Therapeutic quantities of radioactive materials shall be administered only by a physician specifically trained in radiation therapy to perform such procedures. (See AR 40-37.)

b. The radiation therapist shall select a private room most suitable for the radiation protection requirements for the type of radioactive therapy to be administered.

c. The radiation therapist and the RPO shall monitor the patient area and provide radiation protection special instructions and materials to the patient and ward personnel. The radiation therapist shall notify nursing personnel when the radioactive material in the patient's body is to be removed.

d. The RPO shall monitor the patient area and shall indicate a "safe distance" line for visitors.

5-2. Specific Guidelines for Nursing Personnel.

a. Pregnant nursing personnel should not be assigned the duties of caring for radiation therapy patients.

b. Consistent with adequate patient care, carry out only minimal nursing procedures close to the patient. If the patient's clinical status requires constant observation, personnel required to perform adequate nursing care should be beyond the reproductive age. The patient's bed shall be approached ONLY when required by nursing duties.

c. Nursing personnel shall wear a film badge and a self-reading pocket dosimeter while in the patient area. The film badge of another employee shall NOT be used.

d. A television set, telephone, books, etc., may be provided the patient.

e. Notify the radiation therapist who administered the radioactive material and the RPO (NOTE: Instructions on how to contact the RPO should be inserted here.) if any of the following occur:

(1) Major surgery.

(2) Transfer of patient.

(3) Death of the patient (the source should be removed before the body is taken to the morgue).

f. The patient may have visitors. Visitors should stay on the "safe" side of the line indicated on the floor.

g. Place soiled linens, etc., in the designated containers for monitoring by the RPO.

h. Personnel are not to remain in the room unless engaged in a specific activity. Custodial, utility, maintenance, and food service personnel should not enter the room unless they receive permission and instructions from the ward nurse.

i. Excreta, etc., may be handled in the routine manner except for implants that could be excreted via the urinary system.

j. Special handling of the food tray is not required.

k. In the event of a suspected loss or dislodgement of the sealed source, notify the radiation therapist and the RPO (NOTE: Instructions on how to contact the RPO should be inserted here). DO NOT remove any containers or linens from the room, nor flush the toilet, nor use the sink. The radioactive source shall be handled ONLY with forceps.

l. The room shall NOT be returned to general use (i.e., by another patient) until a radiation survey has been performed by the RPO.

5-3. Safety Procedures for the Technicians.

a. After-loading devices shall be used whenever medically acceptable.

b. Jigs should be prepared and evaluated for ease in loading sources into after-loading devices in the patient's room.

c. Jigs for loading the after-loaders shall be set up behind appropriate shields with lead glass viewing windows, and auxiliary lead brick shielding shall be provided to shield the arms of personnel loading the after-loaders for as much of the duration of the procedure as is possible.

d. While manipulating radiation sources, loading the after-loaders and threading needles, personnel shall be provided with tongs or other handling tools to maintain the distance of the fingers preferably about 12 inches (30 cm) or more from these sources.

e. When after-loading sleeves or ovoids are loaded, they shall be placed in adequately shielded carts for sterilization and for transport to the patient's room.

f. Finger dosimeters as well as whole-body dosimeters (film badges) and a self-reading pocket dosimeter shall be worn when occupationally exposed to ionizing radiation. The whole-body film badge shall be worn between the shoulders and the hips. (See AR 40-14.)

5-3. References.

a. AR 40-5, Health and Environment.

b. AR 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation.

c. AR 40-37, Licensing and Control of Radioactive Material for Medical Purposes.

d. NCRP Report No. 40, Protection Against Radiation from Brachytherapy Sources.

e. NCRP Report No. 48, Radiation Protection for Medical and Allied Health Personnel.

f. NCRP Report No. 54, Medical Radiation Exposure of Pregnant and Potentially Pregnant Women.

CHAPTER 6

DIAGNOSTIC X-RAY FACILITIES

6-1. General.

a. The fundamental objective of the diagnostic use of ionizing radiation is to obtain optimum diagnostic information with the minimum exposure of the patient, radiology staff, and the general public. The exposure to patients will be kept to a practical minimum consistent with the clinical objective. (See TB MED 62.)

b. Film-processing materials and techniques shall be those recommended by the x-ray film manufacturer or those otherwise tested to insure maximum information content of the developed film. Good quality assurance methods shall be employed to insure optimum results. (See TB MED 62.)

6-2. Radiation Protection Survey.

a. A radiation protection survey is an evaluation of x-ray facilities for conformance with pertinent design and performance standards. Such evaluation includes inspection of the x-ray system, an analysis of its location with reference to controlled and noncontrolled areas, and measurements of radiation levels in the environment arising from operation of the equipment. Radiation protection and quality assurance surveys shall be performed by a qualified expert. (See TB MED 62.)

b. Periodic surveys shall be performed by a qualified expert on all diagnostic x-ray systems. In addition, surveys shall be made of all new x-ray facilities prior to routine use and after any major modifications to existing facilities which may potentially increase the radiation hazard. (See TB MED 62.)

6-3. Safety Procedures for Occupationally-Exposed X-Ray Workers.

a. Only persons whose presence is necessary to the success of the x-ray examination may be present during x-ray exposures. These persons shall wear leaded aprons of at least 0.25-mm lead equivalence. All others shall leave the room or move well within the confines of the control booth.

b. If it is necessary for a patient to be assisted or held during an exposure, it should be done by an individual not occupationally exposed. A lead apron and gloves shall be worn by the person assisting or holding the patient.

c. Bucky slot covers, leaded tower curtains, and other shielding devices provided on the x-ray system shall be used to shield the fluoroscopist.

d. Doors to the x-ray room shall be closed during x-ray exposures.

e. Lead aprons and gonad shields shall be available on all mobile x-ray systems, and the operator shall wear the lead apron.

f. The restrictions and proper use of equipment shall be understood and observed. Appropriate recommendations of the proper use and restrictions of equipment shall be strictly followed to assure avoidance of needless exposure of patients and other personnel in the vicinity.

g. The supervisor and the RPO shall be notified immediately of any accidental exposure to radiation or malfunction of the x-ray equipment.

h. Personnel dosimeters (film badges) shall be worn by all individuals occupationally exposed during radiologic procedures. The whole-body film badge shall be worn under the lead apron between the shoulders and the hips. (See AR 40-14.)

6-4. Safety Procedures for Patients.

a. When possible, the gonads of patients who have not passed the reproductive age should be shielded from the useful x-ray beam.

b. The useful x-ray beam size shall be limited to that which is just adequate for the examination being performed and shall, in no instance, exceed the maximum dimensions of the size film being used. Evidence of proper collimation and/or shielding should appear on all radiographs.

c. The cumulative radiation timer (0 to 5 minutes) should be set for maximum exposure time at the beginning of each fluoroscopic procedure. Thereafter, it should only be reset after it has completely run out of time or the audible signal is sounded.

d. During dental x-ray examinations, gonad (lead apron) shielding should be used for every patient. Thyroid shielding should be used for patients when appropriate. The shielding shall not be a substitute for adequate beam collimation and alignment.

e. General guidance on patient protection during medical and dental x-ray examinations are provided in Chapter 2, TB MED 62.

6-5. References.

a. AR 40-5, Health and Environment.

b. AR 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation.

c. TB MED 62, Management and Control of Diagnostic X-Ray, Therapeutic X-Ray and Gamma-Beam Equipment Having Energies Up to 10 Million Electron Volts.

d. NCRP Report No. 33, Medical X-Ray and Gamma-Ray Protection for Energies Up to 10 MeV (Equipment Design and Use).

e. NCRP Report No. 35, Dental X-Ray Protection.

f. NCRP Report No. 48, Radiation Protection for Medical and Allied Health Personnel.

g. NCRP Report No. 49, Structural Shielding Design and Evaluation for Medical Use of X Rays and Gamma Rays of Energies Up to 10 MeV.

APPENDIX

RADIATION PROTECTION OFFICER'S
INSPECTION CHECKLIST FOR RADIOACTIVE MATERIALS

1. POSTING OF NOTICES AND WARNING SIGNS.

a. Rooms or areas were properly posted to indicate the presence of a controlled (restricted) area [10 CFR 20.203(b); paragraph C-1n(8), AR 40-37; and paragraph 3-2, AR 385-30]?

YES NO NA REMARKS _____

b. Rooms or areas were properly posted to indicate the presence of RADIOACTIVE MATERIAL [10 CFR 20.203(e); paragraph C-1m(8), AR 40-37; and paragraph 3-2, AR 385-30]?

YES NO NA REMARKS _____

c. Rooms or areas were properly posted to indicate the presence of a RADIATION AREA [10 CFR 20.203(b); 10 CFR 34.42; paragraph C-1n(8), AR 40-37; and paragraph 3-2, AR 385-30]?

YES NO NA REMARKS _____

d. Rooms or areas were properly posted to indicate the presence of a HIGH RADIATION AREA [10 CFR 20.203(c); 10 CFR 34.42; paragraph C-1n(8), AR 40-37; and paragraph 3-2, AR 385-30]?

YES NO NA REMARKS _____

e. Rooms or areas were properly posted to indicate the presence of an AIRBORNE RADIOACTIVITY AREA [10 CFR 20.203(d); paragraph C-1n(8), AR 40-37; and paragraph 3-2, AR 385-30]?

YES NO NA REMARKS _____

f. Containers were properly labeled to indicate the presence of RADIOACTIVE MATERIAL [10 CFR 20.203(f)(1); 10 CFR 20.203(f)(2); paragraph C-1n(8), AR 40-37; and paragraph 3-2, AR 385-30]?

YES NO NA REMARKS _____

g. A current copy of 10 CFR 19, 10 CFR 20, a copy of all NRC licenses, DA radioactive material authorizations, and a copy of the operating procedures, applicable to the activities, were properly posted [10 CFR 19.11 and paragraph C-1n(7), AR 40-37]?

YES NO NA REMARKS _____

h. Posting of documents specified in 10 CFR 19.11 was not practicable; therefore, the licensee posted notices in a sufficient number of places which describes the documents and states where they may be examined [10 CFR 19.11 and paragraph C-1n(7), AR 40-37]?

YES NO NA REMARKS _____

i. Current Form NRC-3, Notice to Employees, were posted in a sufficient number of places for use by the individuals who work in or frequented any portion of controlled (restricted) areas [10 CFR 19.11 and paragraph C-1n(7), AR 40-37]?

YES NO NA REMARKS _____

j. A copy of any notice of violation involving radiological working conditions, proposed imposition of civil penalty, or order issued pursuant to 10 CFR, Part 2, was posted within 2 working days after receipt of the notice [10 CFR 19.11 and paragraph C-1n(7), AR 40-37]?

YES NO NA REMARKS _____

k. A copy of the licensee's response, if any, to a notice of violation by the NRC was posted within 2 working days after the dispatch of response to the licensee [10 CFR 19.11 and paragraph C-1n(7), AR 40-37]?

YES NO NA REMARKS _____

l. The documents posted in compliance with 10 CFR 19.11 remained posted for a minimum of 5 working days or until action taken to correct the violation(s) was completed, whichever was later [10 CFR 19.11 and paragraph C-1n(7), AR 40-37]?

YES NO NA REMARKS _____

m. A copy of Section 206 of the Energy Reorganization Act of 1974 (PL 93-438), 10 CFR 21, and operating procedures adopted pursuant to 10 CFR, Part 21, were posted in a sufficient number of places (10 CFR 21.6)?

YES NO NA REMARKS _____

n. Posting of documents, except Section 206 of PL 93-438, specified in 10 CFR 21.6 was not practicable; therefore, the licensee posted notices in a sufficient number of places which describe the documents, including the name of the individual to whom reports are to be made and states where they may be examined (10 CFR 21.6)?

YES NO NA REMARKS _____

- (1) Date of NRC Compliance Inspection: _____
- (2) Date of Receipt of Violation: _____
- (3) Date of Transmittal of Response: _____
- (4) Date of Corrective Action: _____
- (5) Date Documents Were Posted: _____
- (6) Date on Which Documents Were Received: _____
- (7) Date of the Most Recent USAEHA Survey: _____; Report Number: _____

2. RECORDS AND REPORTS.

a. Records of current occupational radiation exposure of radiation workers were properly maintained [10 CFR 20.401; 10 CFR 34.33; paragraph 10, AR 40-14]?

YES NO NA REMARKS _____

b. Records of individual accumulated occupational radiation exposure were maintained for each radiation worker [10 CFR 20.102 and paragraph 10, AR 40-14]?

YES NO NA REMARKS _____

c. Records of Occupational Radiation Exposure (DD Forms 1141) and Dosimeter Application and Record of Occupational Radiation Exposure (DD Form 1952) were maintained separate from the Health Record (paragraph 3-15, AR 40-403)?

YES NO NA REMARKS _____

d. Records of radiation surveys of all the work areas where radioactive material is used and stored were properly maintained [10 CFR 20.201; 10 CFR 20.401; 10 CFR 30.43; and paragraph C-1n(12), AR 40-37]?

YES NO NA REMARKS _____

(1) Frequency of Survey: _____

(2) Date of Last Survey: _____

e. Records of disposal of radioactive material were properly maintained (10 CFR 20.302; 10 CFR 20.303; 10 CFR 20.401; and paragraph C-10, AR 40-37)?

YES NO NA REMARKS _____

f. Records of receipt, transfer, disposal, export of radioactive material were properly maintained [10 CFR 30.41; 10 CFR 30.51; 10 CFR 40.61; 10 CFR 70.51; paragraph C-1n(6), AR 40-37; and paragraph 3-55, AR 40-61]?

YES NO NA REMARKS _____

g. Records of leak tests were maintained as prescribed in the NRC license or DA radioactive material authorization [10 CFR 34.25; 10 CFR 35.14, and paragraph C-1n(1), AR 40-37]?

YES NO NA REMARKS _____

(1) Frequency of Leak Tests: _____

(2) Number of Sealed Sources: _____

(3) Date of Last Leak Tests: _____

h. Records of radioactive material inventories were properly maintained [10 CFR 34.25; 10 CFR 35.14; paragraph C-1n(6), AR 40-37; and paragraph 3-55, AR 40-61]?

YES NO NA REMARKS _____

(1) Frequency of Physical Inventory: _____

(2) Date of Last Inventory: _____

i. Utilization logs were properly maintained (10 CFR 34.27)?

YES NO NA REMARKS _____

j. Records of calibration of radiation survey instruments used for health and safety monitoring of radiation sources were properly maintained (10 CFR 34.24; paragraph 5-37, AR 40-5; paragraph C-1k, AR 40-37; and paragraph 8, TB 43-180)?

YES NO NA REMARKS _____

(1) Frequency of Calibration: _____

(2) Date of Last Calibration: _____

k. Records of bioassay procedure were maintained on all radiation workers as required by the conditions of the NRC license or DA radioactive material authorization (10 CFR 20.108; 10 CFR 20.401; paragraph 10, AR 40-14; and paragraph C-1k, AR 40-37)?

YES NO NA REMARKS _____

(1) Frequency of Bioassay Procedures: _____

(2) Date of Last Bioassay Tests: _____

l. Records of alleged overexposure were properly maintained documenting the investigations (paragraph 5-30, AR 40-5)? (See paragraph 2r.)

YES NO NA REMARKS _____

m. Records of statistical summary report of personnel monitoring information was submitted as required (10 CFR 20.407 and paragraph 13, AR 40-14)?

YES NO NA REMARKS _____

n. Records of training, retraining, and instruction of radiation workers were properly documented [10 CFR 19.12; paragraph 5-27, AR 40-5; paragraph e(6), AR 40-14; and paragraph 4e(8), AR 40-37]?

YES NO NA REMARKS _____

o. Records of wipe test data and results on determination of concentrations of radioactive material (radioactive contamination) present in the working areas and the results of resurveys after decontamination were properly maintained [10 CFR 20.201 and paragraph C-1n (12), AR 40-37]?

YES NO NA REMARKS _____

(1) Frequency of Wipe Tests: _____

(2) Date of Last Wipe Test: _____

p. Reports to individuals and notifications are properly submitted (10 CFR 19.13 and paragraphs 13 and 14, AR 40-14)?

YES NO NA REMARKS _____

q. Reports of incidents and notifications are properly submitted (10 CFR 20.403 and paragraphs 2-19 and 12-1, AR 385-40)?

YES NO NA REMARKS _____

r. Reports of overexposure and excessive levels and concentrations are properly submitted (10 CFR 20.405; paragraph 5-30, AR 40-5; and paragraph 3-3, AR 385-40).

YES NO NA REMARKS _____

s. Reports of theft or loss of NRC licensed radioactive material are properly submitted (10 CFR 20.402 and paragraph 3-3, AR 385-40).

YES NO NA REMARKS _____

t. Radioisotopes in Human Use Activities Report (RCS MED 197) are prepared properly and submitted in a timely manner (paragraph 5, AR 40-37)?

YES NO NA REMARKS _____

u. Reports of personnel exposure on termination of employment or work (10 CFR 20.408 and paragraph 14, AR 40-14)?

YES NO NA REMARKS _____

3. OPERATING PROCEDURES AND MANUALS.

a. The institutional radiation protection instruction program for all radiation workers and hospital employees is operational and effective [10 CFR 19.12; paragraph 4d(6), AR 40-14j; and paragraph 4e(8), AR 40-37]?

YES NO NA REMARKS _____

(1) Frequency of Radiation Protection Instruction: _____

(2) Date of Last Instruction Program: _____

b. A detailed written radiation protection program is prepared and copies properly posted and available for use by all radiation workers, personnel involved in patient care and others who may handle radioactive material (10 CFR 19.12 and paragraph C-h, AR 40-37)?

YES NO NA REMARKS _____

c. Procedures for picking up, receiving and opening of packages containing radioactive material are available and are in routine use [10 CFR 20.205; 10 CFR 71.51; and paragraph C-h (11), AR 40-37]?

YES NO NA REMARKS _____

d. Procedures for the handling of radiation emergencies are available, properly posted and personnel are familiar with the emergency procedures [paragraph 5-26b(1), AR 40-5, and paragraph C-h, AR 40-37]?

YES NO NA REMARKS _____

4. ADMINISTRATIVE PROCEDURES.

a. A RPO and an alternate RPO are designated in writing [10 CFR 35.11; paragraph 4d(2), AR 40-14; and paragraph 4e(3), AR 40-37]?

YES NO NA REMARKS _____

(1) Name of the RPO: _____

(2) Name of the Alternate RPO: _____

b. The Radiation Control Committee has been established in writing [10 CFR 35.11; paragraph 4d(3), AR 40-14; and paragraphs 4e(4) and 4f, AR 40-37]?

YES NO NA REMARKS _____

c. Minutes of the Radiation Control Committee are properly maintained [paragraph 4e(15), AR 40-37]?

YES NO NA REMARKS _____

d. Information and policy statements by command to hospital staff personnel regarding the commitment to maintain exposure to radiation and the release of radioactive effluents to as low as is reasonably achievable (LARA) (10 CFR 20.1)?

YES NO NA REMARKS _____

e. Radioactive materials stored in uncontrolled (unrestricted) areas are secured from unauthorized removal and use (10 CFR 20.207)?

YES NO NA REMARKS _____

f. Radioactive materials used (not in storage) in uncontrolled (unrestricted) areas are tended under the constant surveillance and immediate control of the licensee (10 CFR 20.207)?

YES NO NA REMARKS _____

g. Determine compliance with NRC license and DA radioactive material authorization conditions (10 CFR 30.34 and paragraph 4, AR 40-37)?

YES NO NA REMARKS _____

5. SPECIAL DA REQUIREMENTS.

a. The shipments and receipts of radioactive materials are in accordance with AR 55-55 and TM 55-315?

YES NO NA REMARKS _____

b. Discrepancies in the shipments of radioactive materials are reported in accordance with AR 55-38?

YES NO NA REMARKS _____

c. Deficiencies in the packaging and handling of radioactive materials are reported in accordance with AR 700-58?

YES NO NA REMARKS _____

d. The temporary storage and disposal of unwanted radioactive materials are in accordance with AR 200-1, AR 755-15 and TM 3-261?

YES NO NA REMARKS _____

e. The use of human volunteers as subjects of research are in accordance with AR 40-37 and AR 70-25?

YES NO NA REMARKS _____

f. Sr-90 eye applicators used in the treatment of humans are recalibrated at least once every 3 years as required by paragraph 13, AR 40-37?

YES NO NA REMARKS _____

(1) Date of Last Calibration: _____

(2) Date of Next Calibration: _____

g. Control of Night Vision Adaptometer (NSN 6515-00-382-1000) is in accordance with AR 40-37, AR 40-61 and SB 8-74?

YES NO NA REMARKS _____

h. The Radiation Control Committee has approved the use of radioactive material as required by paragraph 4f, AR 40-37?

YES NO NA REMARKS _____

i. Each human user's personnel record reflects the current qualifications and training of the individual human user as required by paragraph 4e(7), AR 40-37?

YES NO NA REMARKS _____

j. Gas chromatographs are properly vented to the outside environment as required by paragraph C-1n(4), AR 40-37?

YES NO NA REMARKS _____

k. Fume hoods used for the handling of low to moderate levels of radioactive materials have an average face velocity of 100 linear feet per minute as required by paragraph 5-36, AR 40-5, and paragraph C-1m, AR 40-37?

YES NO NA REMARKS _____

l. The local fire and military police officials are informed of the location and nature of the radioactive material at the installation/activity (paragraph 5-39, AR 40-5; and paragraph 11d, AR 755-15)?

YES NO NA REMARKS _____

YES NO NA REMARKS _____

(1) Frequency of Familiarization of Fire and Military Police Officials: _____

(2) Date of Last Visit by Fire and Military Police Officials: _____

m. The local fire department has appropriate radiation survey instruments when required by paragraph 1-6, AR 420-90?

YES NO NA REMARKS _____

n. Custodian of the DD Form 1141 is designated in writing (paragraph 7d, AR 40-14)?

YES NO NA REMARKS _____

Name of Custodian: _____

o. All records, reports, and other documentation in support of the radiation protection program are maintained in accordance with AR 340-18-6?

YES NO NA REMARKS _____